UNIVERSITY OF HAWAII COOPERATIVE EXTENSION SERVICE CIRCULAR 422

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Breeding Stock Selection For Commercial Swine Production

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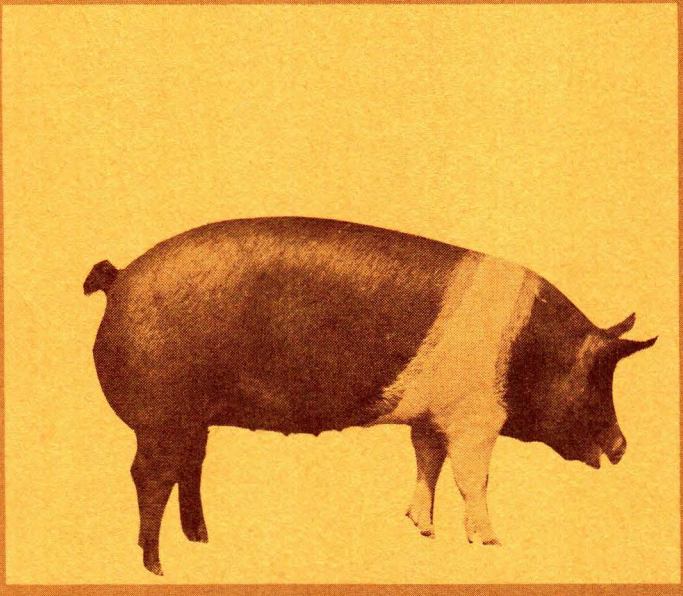

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BREEDING STOCK SELECTION FOR COMMERCIAL SWINE PRODUCTION

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With today's economic and market demands, the basic goal in a swine selection program is to produce fast-gaining, efficient animals yielding carcasses that have a high percentage of quality lean meat. For commercial hog production, the breeding and selection program should:

1. Use the most effective overall system of breeding.
2. Retain superior performing breeding stock.

In commercial swine production, the most effective overall program to follow is a systematic crossbreeding plan. Depending upon the availability of breeds, the most commonly used crossing programs are criss-crossing (two-breed alternate cross) and three- or four-breed rotational crossing programs. (Refer to University of Hawaii Cooperative Extension Service Circular 406.) The most efficient method of selecting breeding stock for use in these crossing programs is by comparing performance records.

SELECTION FACTORS TO CONSIDER

1. Concentrate selection on the important economic traits.

The important economic traits to consider in selection are:

a. Sow productivity.
b. Rate and efficiency of gain.
c. Carcass merit.

Don't be concerned with fancy points. Generally, specific color patterns, shape of ear, length of snout, etc., are of little practical importance to the commercial producer.

2. Select for a minimum of traits.

As the number of traits selected for increases, the rate of improvement for each individual trait is reduced. It simply becomes increasingly difficult to find animals with all the required desirable traits. Thus, the importance of paying attention to the economically important traits and avoiding fancy points.

3. Select for traits that you have a good chance of improving

The performance of any pig is partly due to its genetic makeup and partly due to the environment under which it is raised. The genetic portion of the variation observed in a trait is known as "heritability." The importance that inheritance plays in determining variation in traits have been estimated for most of the performance traits in swine. Some characteristics are influenced by inheritance more than others. Growth rate, feed efficiency, and carcass merit are

traits that are rather highly heritable, so these can be more easily improved in a selection program. Litter size and survival, on the other hand, are traits of low heritability, so they are less likely to be improved by selection. Figure 1 shows some production and carcass traits of swine and their comparative heritability ranking. Note that most of the traits associated with carcass quality are highly heritable, whereas characteristics associated with sow productivity are low.

When a trait is highly heritable, it is possible to more nearly estimate the breeding value of animals directly. Fairly rapid progress can be made by selecting animals for that trait on the basis of their own performance. Mating the "best to the best" will result in improvement of that trait in the offspring. Carcass traits cannot always be measured on the live animal, but an estimate of the leanness of a pig can be obtained by using a live backfat probe. (See Figure 2 for instructions on live backfat probing.) However, when a trait is of low heritability, the differences observed in performance among individuals are largely due to, or caused by, management and feeding practices rather than genetic differences among the animals. These traits with low heritability do not respond much to selection. The use of crossbreeding and improved management and feeding practices will result in the greatest improvement.

4. Select in Terms of Association Between Traits

Many times, traits that are being selected for are correlated. This means that as one trait is being selected for, the other trait will also change. Traits may be either positively or negatively correlated. For example, backfat thickness and car-

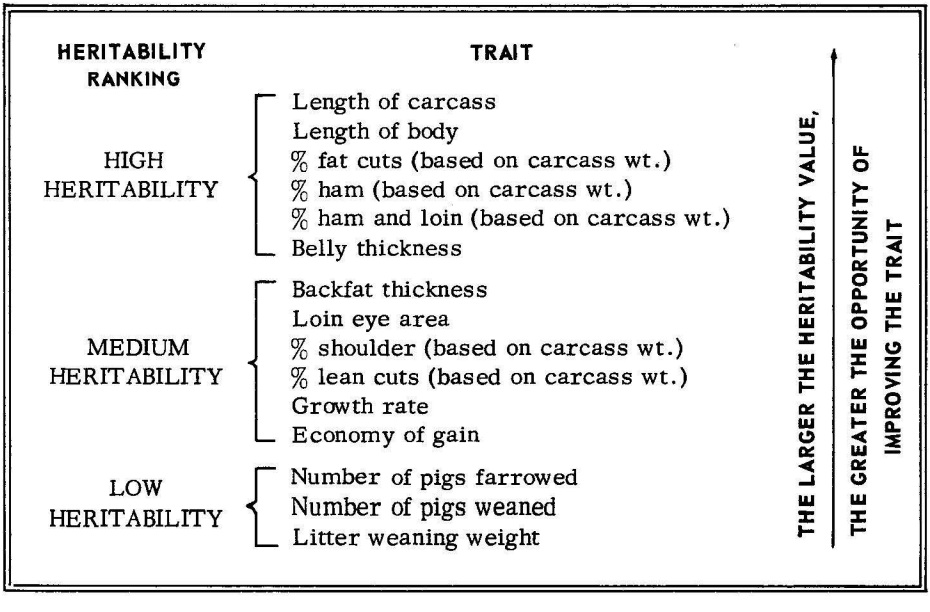
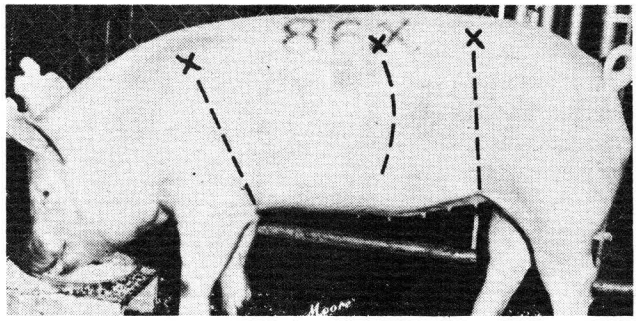
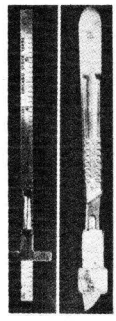


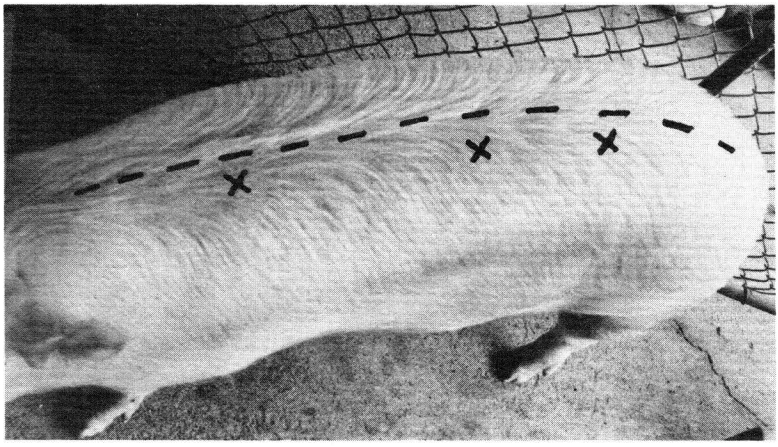
Figure 1. Heritability of some production and carcass traits of swine.



SIDE VIEW OF PIG SHOWING PROBE SITES



RULER AND SCALPEL



TOP VIEW OF PIG SHOWING PROBE SITES

The live backfat probe is useful since measurements can be made directly on prospective breeding animals. The live probes are closely correlated with actual backfat measurements on the corresponding hog carcass and with lean cut yields.

PROCEDURE

1. Wrap knife blade or scalpel 3/8" from the tip. This is to prevent knife from going too deep.
2. Restrain hog with snare.
3. Make a small incision through the skin at a right angle to the hog's body about 2" off the midline.
4. Insert the ruler in the cut slanting it slightly to make a right angle to the pig's back.
5. Force the ruler through the fat to the muscle.
6. Push the clip down to the skin and remove and read.
7. Make probes 2" off the midline of the back at three sides:
   a. Just back of the shoulder in line with the elbow joint.
   b. At the last rib.
   c. At the last lumbar verterbrae or halfway between second probe site and tail setting.
8. Total the three probe measurements and using the pig's actual weight, adjust to a standard weight (see Tables VIII and IX in the Appendix).

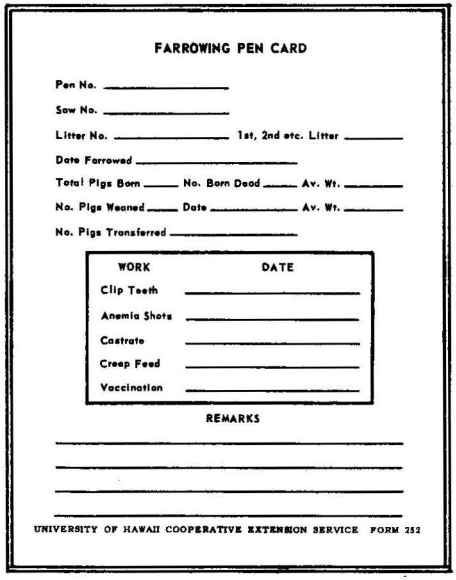
Figure 2. Live backfat probing.

cass meatiness are negatively associated. Thus, as backfat decreases, carcass meatiness increases. Desirable gain is associated with efficient feed utilization. In some instances, where it may not be possible or practical to obtain information on one trait (feed efficiency, for example), some improvement will be made through selection of another trait that may be measured more easily (growth rate, in this example). The associations of some of the production traits in swine are indicated below:

Traits correlated	Correlation
Feed efficiency and	
Carcass lean	Slightly positive
Daily gain and	
Carcass lean	Slightly negative
Feed efficiency	Highly positive
Backfat probe or Carcass backfat and	
Carcass lean	Highly negative
Daily gain	Slightly positive
Feed efficiency	Slightly positive

5. Keep Records.

An accurate record-keeping program is necessary in a good selection program to identify and retain the better-performing animals. The first prerequisite in keeping any record is identification of the animals. All sows, as well as gilt pigs in the litters, in the herd should be identified. One system of ear notching as a means of identification is shown in Figure 5. The more important records to keep are as follows:


FARROWING PEN CARD

Pen No. _____

Sow No. _____

Litter No. _____ 1st, 2nd etc. Litter _____

Date Farrowed _____

Total Pigs Born ____ No. Born Dead ____ Av. Wt. _____

No. Pigs Weaned ____ Date _____ Av. Wt. _____

No. Pigs Transferred _____

WORK	DATE
Clip Teeth	
Anemia Shots	
Castrate	
Creep Feed	
Vaccination	

REMARKS

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Figure 3. Farrowing pen card

a. Farrowing information. Number of pigs born live, date farrowed, defects in the litter, litter number of the sow (1st, 2nd, etc.).
b. Weaning information. Number of pigs weaned, date or age weaned, weaning weight.
c. Weight or age at market time.
d. Live backfat probe at market weight.

Record forms are available from the University of Hawaii Cooperative Extension Service (Forms 251, 252, 271--see Figures 3 and 4).

6. Make Accurate Comparisons.

Remember, you are interested in measuring differences in the genetic makeup of animals not differences in environment. Pigs that are to be compared, one with the other, should be handled under similar rearing conditions. Differences in performance

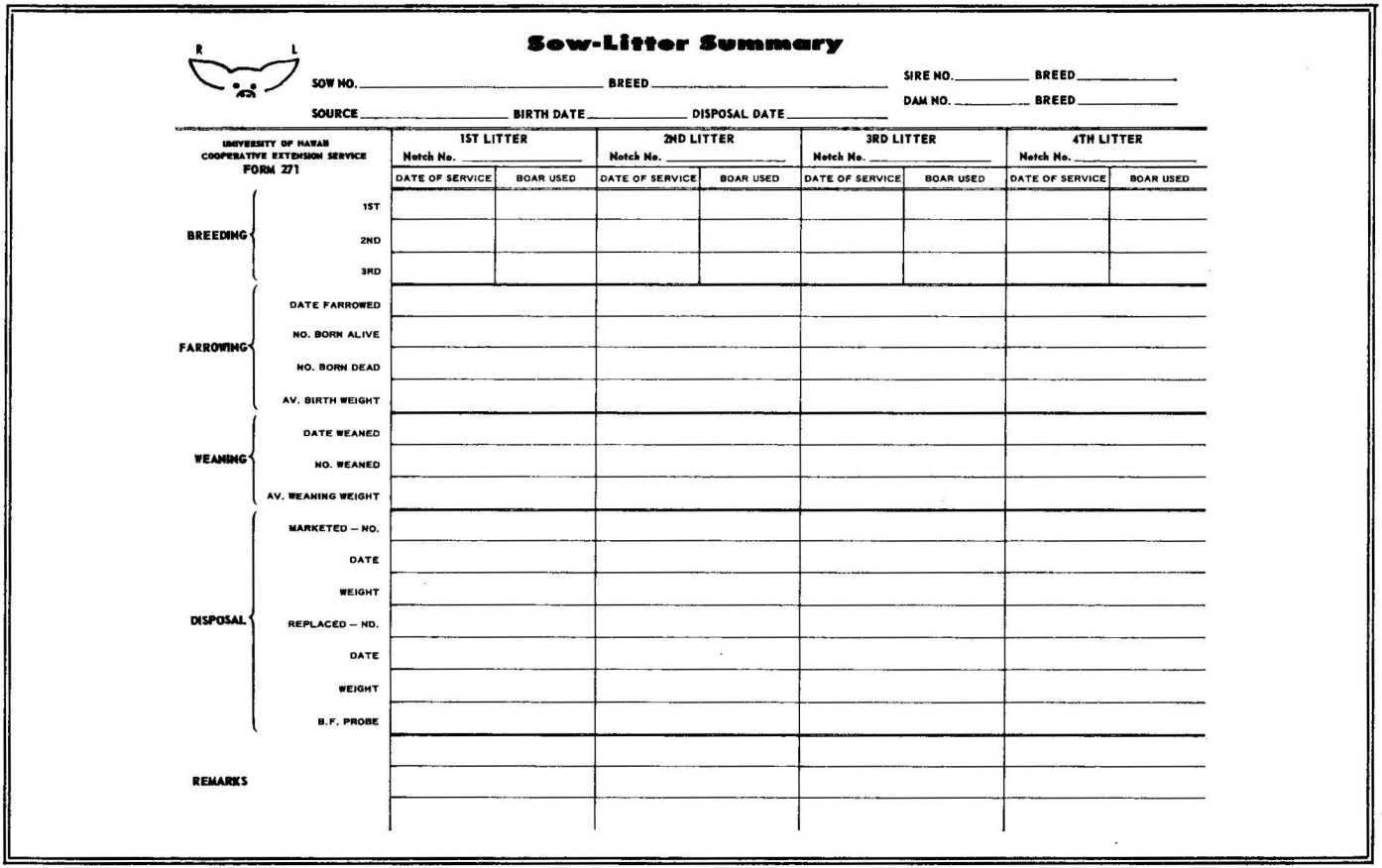


Figure 4. Sow-litter summary

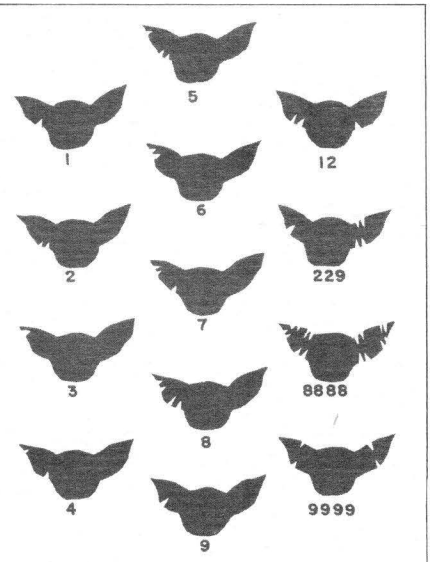
SWINE
EAR NOTCHING
DIRECTIONS

UNIVERSITY OF HAWAII COOPERATIVE EXTENSION SERVICE
FORM 302

The system illustrated provides for the individual notching of ears and numbering of the pigs individually from 0 to 9999. The left ear and the upper right ear carries the litter number. Each pig's notch number and identification is the total of its litter number and individual number. Identification of litters is by 10's--10, 20, 30, 40, etc., up to litter 9990. Pigs within litters are numbered individually starting with 0 (no individual mark) and running consecutively to 9. This accounts for 10 pigs. If only the gilts within a litter are notched, seldom will they ever exceed 10 in number, and no duplication of notch number within a litter will occur. If both males and females within a litter are to be notched, it is best to notch pigs of one sex first. Then, if there are more than 10 pigs in a litter, although some may have the same notch number, they will be of the opposite sex.

The diagram illustrates all the basic notches used in the system. No one pig would, however, have all the notches indicated.

Illustrations of notching and numbering are given at right.



SWINE EAR NOTCHING

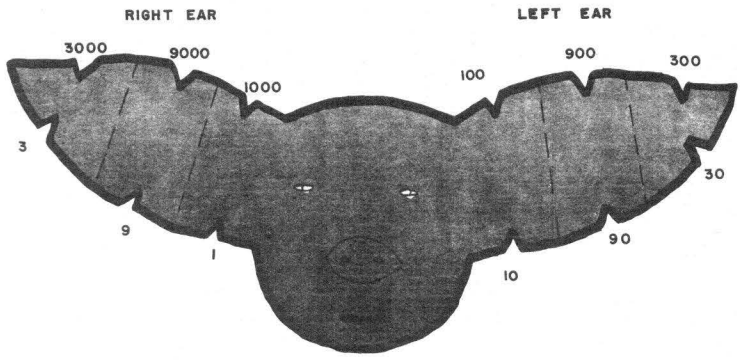


Figure 5. Ear notching method

will exist between pasture and dry lot-fed pigs, full-fed and limited-fed pigs, gilt and sow litters, and between sexes.

7. Standardize Records

Data on animals being selected must be on the same basis if accurate comparisons are to be made. Tables I to VIII in the Appendix can be used for adjusting weights and live backfat probes to standard age and weight.

8. Avoid Using Animals With Defects

Animals selected should have sound feed and legs, evidence of good length and balanced conformation, and be out of litters that are free of defects. Most of the inherited defects are recessive in nature, which means that both the boar and sow contribute to the defect showing up in the offspring. Table 8 in the Appendix indicates some of the more commonly inherited defects found in swine.

9. Select More Gilts Than Needed

In gilt selection, select 15 to 20 percent more than needed for actual replacements. This will allow for later culling of nonbreeders and animals with possible unsoundness.

PROGRESS IN SELECTION

In a selection program, as the level of performance in the herd improves, it generally becomes more difficult to make progress. Consequently, as time goes along, greater emphasis must be given to the performance of the boars being utilized in the herd. Also, additional practices will have to be incorporated into the program of selecting replacement gilts. The use of performance and carcass data on littermates and other relatives of the prospective gilt replacements should be used in addition to the performance of the gilt herself.

Performance requirements in a selection program should be somewhat flexible rather than rigid, fixed standards. This will permit adjusting the emphasis of the program as the performance situation within the herd changes. In the end, the improvement that results from the breeding program will depend upon:

1. How much the traits selected for are under genetic control,
2. How intense the selection is,
3. How often each generation is turned over.

SELECTION METHODS

There are three basic methods of selection:

1. Improving one trait at a time to a satisfactory level and then the next one, and so on. The disadvantage of this system is that the value of an animal doesn't rest on one trait only.

2. Establishing an independent culling level. A minimum level of merit for each trait is set and all individuals' performance below the established level of a trait is culled regardless of performance in other traits. Although this practice allows for culling of animals based on traits that can be measured early in life, it doesn't permit the retention of animals that may be highly superior in some traits.

3. Index method, in which the total animal is evaluated on its perform-

Table 1. Heredity abnormalities occurring in swine

Type of defect	Description
Atresia ani	Closure of the rectum. Pigs are born alive. Boar pigs will usually die in a couple of days due to obstruction. In gilt pigs, although the anus is closed, usually an opening is found in the ventral side of the rectum. These gilt pigs may live--some even to maturity.
Brain hernia	Pigs born alive, but hole in skull allows brain tissue to extrude.
Catlin mark	Incomplete development of the skull.
Cleft palate	Pigs born alive but usually unable to nurse.
Hydrocephalus	Fluid found outside the brain, head is enlarged. Young pigs are either born dead or die within a few days after birth. Condition often accompanied by light coat color and short tails.
Legless	Pigs born alive but without legs.
Muscle contracture	Front legs of the pig are rigid, occasionally hind legs. Affected pigs are usually stillborn or die shortly after birth.
Paralysis of hindlegs	Hindlegs are paralyzed. Affected pigs cannot rise and walk but only able to crawl by means of the front legs. Animals usualyl starve to death.
Split ear	Ears are split to the base forming two lobes. Often accompanied by deformed hindquarter and cleft palate.
Thickened fore-limbs	Thickening of the fore-limbs due to muscle tissue being replaced by connective tissue. Pigs usually born alive.
Cryptorchidism	One or both testicles retained in the body cavity and not edd cended into the scrotum.
Hairlessness	Animals born with little or no hair. This should not be confused with hairlessness due to iodine deficiency.
Hemophilia	Blood fails to clot promptly. Usually first evidences at about two months of age, becomes more severe as animal ages.
Inverted nipples	Nipple resembles pit or crater in breast and is nonfunctional.
Scrotal hernia	Intestine extending into the scrotum.
Mule foot	Solid hoof similar to that of a mule.
Polydactyl	Extra toes.
Wattles	Usually occur in pairs, covered by normal skin.
Kinky tail	Usually characterized by rigid angles in tail. Evident at birth.
Unequal toes	Unequal development in the length and diameter of the member of the toe pairs.

ance in all of the chosen traits. Animals are ranked and selection based on highest ranking individuals.

In practice, performance measurements of all traits are not obtained at the same time. Usually, there will be some culling practiced as pigs develop rather than waiting to the end to get a total evaluation on all traits for all animals under consideration.

SUGGESTED REQUIREMENTS FOR GILTS

Fed Out on Grain Feeding Program

1. Growth rate: 175 pounds at 5 months of age (or 200 pounds at 6 months.

2. Backfat: not over 1.2 inches at 175 pounds (or 1.4 inches at 200 pounds).

3. Nipples: not less than 12, well spaced, and none inverted.

4. Feet and legs: sound with good bone.

5. Conformation: good length, balance, and muscular.

6. Cut out carcass information on littermate barrows (200 pounds): loin eye, 4 square inches; carcass length, 29 inches; backfat, 1.5 inches or less. (See Figure 6 to 8.)

7. Free from diseases and abnormalities.

8. From a litter of eight or more pigs.

BOAR SELECTION

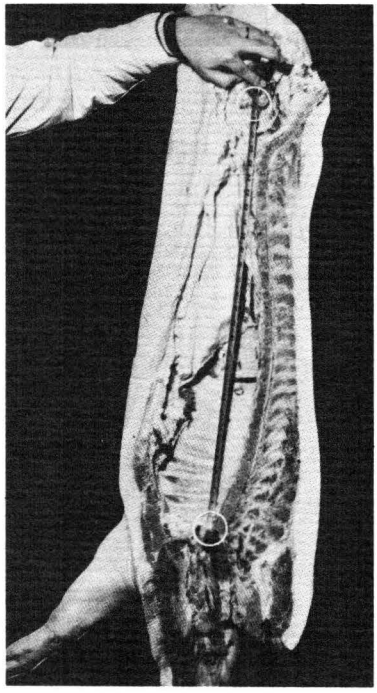
Although most commercial producers do not produce their own boars, all should be concerned about securing quality boars to use in the herd. Much of the progress within a herd will be due to the boar. When only one or two boars are used in a herd, it is particularly critical to be selecting genetically better boars each generation. In selecting a boar, it is important to know what the performance of the female herd is so as to be able to select boars to improve weaknesses in the herd.

In selecting a boar to use in the herd, the following points should be remembered:

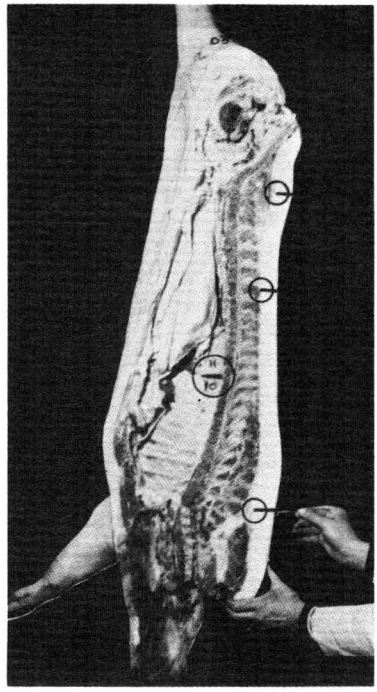
1. Secure boars from breeders that have reliable records on their hogs. If possible, go to a breeder who has several breeds of boars available so that stock can be secured each year to fit into the crossing program.

2. Give preference to performance-tested boars out of herds that are fully tested. Boars with records are seldom too high in price. However, a boar with no records can be costly simply by reducing the overall performance and quality of the offspring. Information should be available on litter size, growth rate, feed efficiency, and backfat probe. However, don't buy a boar just because he has been tested. The testing procedure in itself does nothing to make the boar any better or worse--it simply gives an indication of its potential genetic merit.

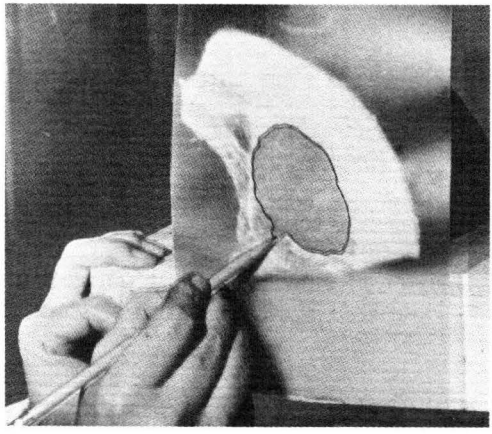
3. In appraising records on boars, remember the following:



LENGTH



BACKFAT



LOIN EYE

Figure 6. Carcass measurements.

a. Ration fed--full-fed or restricted: Boars should not be slowed down in growth so as to appear leaner.
b. Sex consideration: Remember, there are differences. Boars gain slightly faster than barrows or gilts, take less feed per pound of gain, and have longer carcasses. Gilts are leaner than barrows. Consequently, use a boar with less backfat than you want his offspring to have.
c. Feed records: Test animals should be fed to market weight. If testing period is terminated at an early age, the feed efficiency will appear better than it should, since lighter pigs are more efficient as compared with heavier ones.

4. If the size of the herd justifies it, consideration should be given to purchasing several boars. This will reduce the possibility of introducing a boar that could adversely affect the entire herd if bred to all sows. Progress might be a little slower, but it will be more certain.

5. The breeder of the boars should be participating in a sound disease control program. Boars should be from validated herds.

6. Purchase boars early--at least 30 days before use. Isolate him from the rest of the herd. Test-breed him on some market gilts, and manage and feed him properly.

7. Know the breeder's guarantee on the boars purchased. Generally, most reputable sellers of purebred breeding stock follow the guarantee as suggested by the National Association of Swine Records (see Figure 7).

SUGGESTED REQUIREMENTS FOR BOARS

1. Weaning weight: Boars from gilt litters should weigh at least 24 pounds at 6 weeks or 35 pounds at 8 weeks.

2. Age at 200 pounds: Boars should reach this weight at 5 months of age.

3. Backfat probe at 200 pounds liveweight: Not over 1.1 inches.

4. Mammary development: At least 6 well spaced, developed, rudimentary teats on each side. Avoid selecting boars with blind teats.

5. Conformation: Boars should show evidence of meatiness, display good length of body, heavy ham, and good bone.

6. Feed efficiency records: Should not be over 300 pounds of feed per 100 pounds of gain (50 to 200 pounds).

7. Litter size: Boars should come from a litter with at least 8 pigs farrowed and weaned.

8. Carcass data on littermate: Try to obtain boars that come from certified litters or are sired by certified sires or superior meat sires. Littermates (at 200 pounds) should meet the following carcass certification: length, 29 inches; backfat, not more than 1.5 inches (1.2 to 1.3 inches are preferred); loin eye area, minimum of 4 square inches.

A Revised Code of Fair Practice

FOR BUYERS AND SELLERS OF REGISTERED PUREBRED HOGS

Adopted and Recommended by National Association of Swine Records

The buyer of a purebred boar or gilt has every right to expect it to be a breeder. However, there are many things which may affect an animal's usefulness in the breeding pens, some of which may not be visible at time of purchase and others which may be the result of subsequent care and handling. Therefore, any guarantee must be a sharing of the responsibility.

Over the years certain procedures have been found to be equitable and fair to both buyer and seller. It is the purpose of this "code" to provide the buyer with a basis of understanding of which he has a right to expect, and the seller with similar guides on the extent of his responsibility. In drawing up this outline, the Association of Swine Records assumes no responsibility for its enforcement. All guarantees are between buyer and seller.

GENERAL PROVISIONS

(1) REGISTRATION—In all purebred transactions, the certificate of registration is an integral part of the transaction, and shall be delivered to the purchaser, properly transferred on the Association records at the seller's expense.

(2) HEALTH—Sellers are obligated by law to provide a health certificate specifying the types and kinds of vaccinations; blood tests showing diseases to which animal is negative; and a statement of good health.

See your veterinarian for these regulations.

(3) TRANSPORTATION—When an adjustment involves the exchange of an animal by public carrier such expense shall be shared equally by buyer and seller.

(4) MAINTENANCE—No charge for feed or maintenance shall be made by either buyer or seller.

(5) ANIMALS UNDER 5 MONTHS—Because subsequent feed and care can so greatly affect the future usefulness for breeding purposes of animals under 5 months of age at time of sale, the seller cannot be reasonably expected to make any adjustments.

STANDARD GUARANTEE FOR BOARS

All boars after they have reached 7 months of age are guaranteed breeders **except** when let run with the sow herd. Should any boar fail to serve or settle sows, the seller shall make a replacement satisfactory to the buyer or refund the purchase price when the boar is returned, retested and negative to same blood tests as when sold and in satisfactory state of flesh; or the seller may direct the marketing of the boar and refund the difference between the purchase price and market value as shown by sales receipt.

No adjustment will be completed until certificate of registry is re-transferred to seller.

However, the seller shall always have the right if he so desires, to try a boar for as much as 30 days before making final adjustment to determine his usefulness or lack of usefulness as a breeder.

All requests for adjustment under this guarantee must be made through the mails within 6 weeks of date of sale or within 6 weeks after boar becomes 7 months of age. No charge for feed or maintenance shall be made by either buyer or seller.

STANDARD GUARANTEE FOR OPEN GILTS

All open females over 7 months of age are guaranteed open and breeders. Should any prove to be bred, she may be returned at the seller's expense and the purchase price refunded. Should any prove to be non-breeders, the seller shall make a satisfactory replacement or refund the purchase price when the animal is returned, retested and negative to same blood tests as when sold and in a satisfactory state of flesh. Or in either case the seller may direct the marketing of such animals and refund the difference between the purchase price and the market value as shown by sales receipt.

No adjustment will be completed until certificate of registry is re-transferred to seller.

However, the seller shall always have a right if he so desires, to hold a claimed non-breeder 45 days to determine whether she is with pig or settles immediately before making final adjustment.

All claims for adjustment shall be made through the mails within 3 calendar months of the date of sale.

STANDARD BRED SOW GUARANTEE

All bred sows are guaranteed to be with pig to the indicated boar and date of service. Any proving otherwise may be returned and exchanged for another sow satisfactory to the purchaser, or refund of the purchase price, if the sow is returned, retested and negative to same blood tests as when sold and in satisfactory state of flesh: and upon re-transfer of certificate of registry to seller.

If a buyer wishes to retain the sow, the seller shall return one-half the difference between the purchase price and the market value of the sow at time of purchase.

The seller may direct the marketing of the sow and refund the difference between the purchase price and the market value of the sow as shown by sales receipt and upon return of certificate of registry.

All claims for adjustment must be made within 114 days of the indicated date of service. However, purchasers are warned that a sow may farrow as much as a week before, or a week later than this estimated farrowing date. No guarantee is made as to the number or quality of pigs a sow will farrow or raise, unless seller specifies same in writing.

Figure 7. A revised code of fair practice

SUMMARY

Basic Steps in Commercial Gilt Selection

1. Birth--Ear notch and record birth dates of gilt pigs from the best litters.
2. Weaning--Cull poorer performing sows and litters.
3. Market weight--

   Weigh the gilts and adjust weight to a standard age.

   Backfat probe the gilts and adjust to a standard weight.

   Select the faster growing gilts with the least amount of backfat.

   Reject off-type, unsound, or diseased gilts.

   Select 15 percent more gilts than needed to allow for later culling.

APPENDIX WEIGHT CONVERSION TABLES

Table I. Converting weight to 28-day age basis*

Age in days	If weight is 12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52
18	20	24	27	31	34	37															
19	19	22	25	29	32	35	38														
20	18	21	24	27	30	33	36	39													
21	17	20	22	25	28	31	34	36	39												
22	16	19	21	24	27	29	32	34	37	40											
23	15	18	20	23	25	28	30	33	35	38	40										
24	14	17	19	22	24	26	29	31	34	36	38	41									
25	14	16	18	20	23	25	27	30	32	34	36	39	41								
26	13	15	17	19	22	24	26	28	30	33	35	37	39	41							
27	12	14	17	19	21	23	25	27	29	31	33	35	37	39	42						
28																					
29		13	15	17	19	21	23	25	27	29	31	33	34	36	38	40					
30		13	15	16	18	20	22	24	26	28	29	31	33	35	37	39	40				
31			14	16	18	19	21	23	25	27	28	30	32	34	36	37	39	41			
32				15	17	19	21	22	24	26	27	29	31	33	34	36	38	39	41		
33				15	17	18	20	21	23	25	26	28	30	31	33	35	36	38	40	41	
34					16	18	19	21	22	24	26	27	29	30	32	34	35	37	38	40	42
35					16	17	19	20	22	23	25	26	28	30	31	33	34	36	37	39	40
36					15	16	18	19	21	22	24	25	27	28	30	31	33	34	36	37	39
37					15	16	17	19	20	22	23	25	26	28	29	31	32	33	35	36	38
38					14	16	17	18	20	21	23	24	25	27	28	30	31	33	34	35	37

* Adapted from University of Illinois Extension Circular 868).

Table II. Converting weight to 35-day age basis*

Age in days	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50
21	25	29	32	36	40	43	47	50											
22	24	27	31	34	37	41	44	48	51										
23	23	26	29	32	36	39	42	45	48	52									
24	21	25	28	31	34	37	40	43	46	49	52								
25	20	23	26	29	32	35	38	41	44	47	50	53							
26	20	22	25	28	31	34	36	39	42	45	48	50	53						
27	19	21	24	27	29	32	35	37	40	43	46	48	51	54					
28	18	20	23	26	28	31	33	36	39	41	44	46	49	51	54				
29	17	20	22	25	27	30	32	35	37	39	42	44	47	49	52	54			
30	17	19	21	24	26	28	31	33	36	38	40	43	45	47	50	52			
31	16	18	21	23	25	27	30	32	34	37	39	41	43	46	48	50	53		
32	15	18	20	22	24	26	29	31	33	35	37	40	42	44	46	49	51	53	
33	15	17	19	21	23	26	28	30	32	34	36	38	40	43	45	47	49	51	53
34	14	16	18	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49	52
35																			
36	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	42	44	46	48
37	13	15	17	19	21	22	24	26	28	30	32	34	36	38	39	41	43	45	47
38	13	15	16	18	20	22	24	25	27	29	31	33	35	36	38	40	42	44	46
39	12	14	16	18	19	21	23	25	27	28	30	32	34	35	37	39	41	42	44
40	12	14	15	17	19	20	22	24	26	27	29	31	32	34	36	38	39	41	43
41	11	13	15	16	18	20	21	23	25	26	28	30	31	33	35	36	38	40	41
42	11	13	14	16	18	19	21	22	24	26	27	29	30	32	34	35	37	38	40
43	11	12	14	15	17	19	20	22	23	25	26	28	29	31	32	34	36	37	39
44	10	12	13	15	16	18	19	21	22	24	25	27	28	30	31	33	34	36	37
45	10	12	13	14	16	17	19	20	22	23	25	26	28	29	31	32	33	35	36

* Adapted from University of Illinois Extension Circular 868).

Table III. Converting weight to 56-day age basis

Age in days	If weight is																								
	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70
47	26	28	31	33	36	38	41	43	46	49	51	54	56	59	61	64	67	69	72	74						
48	25	27	30	32	35	37	40	42	45	47	50	52	55	57	60	62	64	67	69	72	74					
49	24	26	29	31	34	36	38	41	43	46	48	51	53	55	58	60	63	65	67	70	72	75				
50	23	25	28	30	33	35	37	40	42	44	47	49	51	54	56	58	61	63	65	68	70	73	75			
51	23	25	27	30	32	34	36	39	41	43	45	48	50	52	55	57	59	61	64	66	68	71	73	75		
52	22	24	26	29	31	33	35	38	40	42	44	46	49	51	53	55	58	60	62	64	66	69	71	73	75	
53	21	24	26	28	30	32	34	37	39	41	43	45	47	50	52	54	56	58	60	62	65	67	69	71	73	75
54	21	23	25	27	29	31	33	36	38	40	42	44	46	48	50	52	55	57	59	61	63	65	67	69	71	73
55	20	22	25	27	29	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59	61	63	66	68	70	72
56																										
57	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49	51	53	55	57	58	60	62	64	66	68
58	19	21	23	25	27	29	30	32	34	36	38	40	42	44	46	48	50	51	53	55	57	59	61	63	65	67
59	19	20	22	24	26	28	30	32	33	35	37	39	41	43	45	47	48	50	52	54	56	58	60	61	63	65
60	18	20	22	24	25	27	29	31	32	34	36	38	40	42	44	45	47	49	51	53	55	56	58	60	62	64
61	18	20	21	23	25	27	28	30	32	34	35	37	39	41	43	44	46	48	50	52	53	55	57	59	60	62
62	17	19	21	23	24	26	28	30	31	33	35	37	38	40	42	44	45	47	49	50	52	54	56	57	59	61
63	17	19	20	22	24	26	27	29	31	32	34	36	37	39	41	43	44	46	48	49	51	53	55	56	58	60
64	17	18	20	22	23	25	27	28	30	32	33	35	37	38	40	42	43	45	47	48	50	52	53	55	57	58
65	16	18	20	21	23	25	26	28	29	31	33	34	36	38	39	41	43	44	46	47	49	51	52	54	56	57

$$\text{56-day weight} = \text{actual weight} \times \frac{(41)}{(\text{age} - 15)} \; *$$

* Whately and Quaife (Record of Proc. Amer. Soc. Animal Prod., 37: 126).

Table IV. Converting weight to 140-day age basis

Age in days	If weight is																								
	100	105	110	115	120	125	130	135	140	145	150	155	160	165	170	175	180	185	190	195	200	205	210	215	220	225
130	114	120	126	132	137	143	149	155	160	166	172	177	183	189	195	200	206	212								
131	113	119	124	130	136	141	147	152	158	164	169	175	181	186	192	198	203	209	215							
132	111	117	123	128	134	139	145	150	156	162	167	173	178	184	189	195	201	206	212							
133	110	115	121	126	132	137	143	148	154	159	165	170	176	181	187	192	198	203	209	214						
134	108	114	119	125	130	135	141	146	152	157	163	168	173	179	184	190	195	200	206	211	217					
135	107	112	118	123	128	134	139	144	150	155	160	166	171	176	182	187	192	198	203	208	214					
136	105	111	116	121	127	132	137	142	148	153	158	163	169	174	179	185	190	195	200	206	211					
137	104	109	114	120	125	130	135	140	146	151	156	161	166	172	177	182	187	192	198	203	208	213				
138	103	108	113	118	123	128	133	139	144	149	154	159	164	169	174	180	185	190	195	200	205	210	216			
139		106	111	116	122	127	132	137	142	147	152	157	162	167	172	177	182	187	192	198	203	208	213	218		
140																										
141		104	108	113	118	123	128	133	138	143	148	153	158	163	168	173	178	182	187	192	197	202	207	212		
142			107	112	117	122	127	131	136	141	146	151	156	161	165	170	175	180	185	190	195	200	204	209		
143			106	110	115	120	125	130	135	139	144	149	154	159	163	168	173	178	183	187	192	197	202	207	211	
144			104	109	114	119	123	128	133	138	142	147	152	157	161	166	171	175	180	185	190	194	199	204	209	213
145			103	108	112	117	122	126	131	136	140	145	150	155	159	164	169	173	178	183	187	192	197	201	206	211
146				106	111	116	120	125	129	134	139	143	148	153	157	162	166	171	176	180	185	190	194	199	203	208
147				105	110	114	119	123	128	132	137	141	146	151	155	160	164	169	173	178	183	187	192	196	201	205
148				104	108	113	117	122	126	131	135	140	144	149	153	158	162	167	171	176	180	185	189	194	198	203
149					107	111	116	120	125	129	133	138	142	147	151	156	160	165	169	173	178	182	187	191	196	200
150					105	110	114	118	123	127	132	136	140	145	149	154	158	162	167	171	176	180	184	189	193	198

Table V. Converting weight to 154-day age basis

Age in days	If weight is																			
	130	135	140	145	150	155	160	165	170	175	180	185	190	195	200	205	210	215	220	225
148	140	145	151	156	161	167	172	178	183	188	194	199	205	210	215	221	226	231		
149	138	143	149	154	159	165	170	175	181	186	191	197	202	207	213	218	223	229	234	239
150	136	142	147	152	157	163	168	173	178	184	189	194	199	205	210	215	220	226	231	236
151	135	140	145	150	156	161	166	171	176	181	187	192	197	202	207	213	218	223	228	233
152	133	138	143	148	154	159	164	169	174	179	184	189	195	200	205	210	215	220	225	230
153	131	137	142	147	152	157	162	167	172	177	182	187	192	197	202	207	212	218	223	228
154																				
155	128	133	138	143	148	153	158	163	168	173	178	183	188	193	198	202	207	212	217	222
156	127	132	137	141	146	151	156	161	166	171	176	180	185	190	195	200	205	210	215	220
157	125	130	135	140	145	149	154	159	164	169	174	178	183	188	193	198	202	207	212	217
158	124	129	133	138	143	148	152	157	162	167	171	176	181	186	191	195	200	205	210	214
159	122	127	132	136	141	146	151	155	160	165	169	174	179	184	188	193	198	202	207	212
160	121	126	130	135	140	144	149	153	158	163	167	172	177	181	186	191	195	200	205	209
161	120	124	129	133	138	143	147	152	156	161	166	170	175	179	184	189	193	198	202	207

For weights or ages outside the range of this table, use the formula: 154-day weight = $94 \times \frac{\text{actual weight}}{\text{age in days} - 60}$ *

* Modification of Bywaters and Wilham (Proc. Amer. Soc. Animal Prod., 35: 116).

Table VI. Converting weight to 180-day age basis*

Age in days	If weight is 150	152	154	156	158	160	162	164	166	168	170	172	174	176	178	180	182	184	186	188	190	192	194	196	198	200
160	180	182	185	187	190	192	194	197	199	202	204	206	209	211	214	216	218	221	223	226	228	230	233	235		
161	178	181	183	185	188	190	192	195	197	200	202	204	207	209	211	214	216	219	221	223	226	228	230	233	235	
162	176	179	181	183	186	188	190	193	195	198	200	202	205	207	209	212	214	216	219	221	223	226	228	230	233	235
163	175	177	179	182	184	186	189	191	193	196	198	200	203	205	207	210	212	214	217	219	221	224	226	228	231	233
164	173	175	178	180	182	185	187	189	192	194	196	198	201	203	205	207	210	212	214	217	219	221	224	226	228	231
165		174	176	178	181	183	185	187	190	192	194	197	199	201	203	206	208	210	213	215	217	219	222	224	226	228
166			174	177	179	181	183	186	188	190	192	195	197	199	201	204	206	208	211	213	215	217	220	222	224	226
167				175	177	179	182	184	186	188	191	193	195	197	200	202	204	206	209	211	213	215	217	220	222	224
168					176	178	180	182	184	187	189	191	193	196	198	200	202	204	207	209	211	213	216	218	220	222
169						176	178	181	183	185	187	189	192	194	196	198	200	203	205	207	209	211	214	216	218	220
170						175	177	179	181	183	185	188	190	192	194	196	199	201	203	205	207	209	212	214	216	218
171						173	175	177	179	182	184	186	188	190	192	195	197	199	201	203	205	208	210	212	214	216
172							174	176	178	180	182	184	186	188	191	193	195	197	199	201	203	206	208	210	212	214
173								174	176	178	181	183	185	187	189	191	193	195	198	200	202	204	206	208	210	212
174									175	177	179	181	183	185	187	190	192	194	196	198	200	202	204	206	208	211
175										175	177	179	181	184	186	188	190	192	194	196	198	200	202	204	207	209
176											176	178	180	182	184	186	188	190	192	194	196	199	201	203	205	207
177												176	179	181	183	185	187	189	191	193	195	197	199	201	203	205
178													177	179	181	183	185	187	189	191	193	195	197	199	201	203
179														177	179	181	183	185	187	190	192	194	196	198	200	202
180																										
181																179	181	183	185	186	188	190	192	194	196	198
182																	179	181	183	185	187	189	191	193	195	197
183																		180	182	184	186	187	189	191	193	195
184																			180	182	184	186	188	190	191	193
185																				180	182	184	186	188	190	192
186																					181	183	185	187	188	190
187																					180	181	183	185	187	189
188																						180	182	184	186	188
189																							180	182	184	186
190																								181	183	185
191																								180	181	183
192																									180	182
193																									179	180
194																										179

(Table VI continued on next page)

* Taken from Iowa Miscellaneous Publication AH-706 by Ralph Durham, Extension Animal Husbandman

Table VI (Continued). Converting weight to 180-day age basis

Age in days	If weight is 202	204	206	208	210	212	214	216	218	220	222	224	226	228	230	232	234	236	238	240	242	244	246	248	250	252	254
160																											
161																											
162																											
163	235																										
164	233	235																									
165	231	233	235																								
166	229	231	233	235																							
167	226	229	231	233	235																						
168	224	227	229	231	233	236																					
169	222	225	227	229	231	233	235																				
170	220	223	225	227	229	231	233	235																			
171	218	221	223	225	227	229	231	233	236																		
172	216	218	221	223	225	227	229	231	233	236																	
173	215	217	219	222	223	225	227	229	231	234	236																
174	213	215	217	219	221	223	225	227	230	232	234	236															
175	211	213	215	217	219	221	223	225	227	229	232	234	236														
176	209	211	213	215	217	219	221	223	225	227	230	232	234	236													
177	207	209	211	213	215	218	220	222	224	226	228	230	232	234	236												
178	205	207	210	212	214	216	218	220	222	224	226	228	230	232	234	236											
179	204	206	208	210	212	214	216	218	220	222	224	226	228	230	232	234	236										
180																											
181	200	202	204	206	208	210	212	214	216	218	220	222	224	226	228	230	232	234	236								
182	199	201	203	205	207	209	211	214	215	216	218	220	222	224	226	228	230	232	234	236							
183	197	199	201	203	205	207	209	211	213	215	217	219	221	223	224	226	228	230	232	234							
184	195	197	199	201	203	205	207	209	211	213	215	217	219	220	222	224	226	228	230	232	234						
185	194	196	198	200	202	204	205	207	209	211	213	215	217	219	221	223	225	227	228	230	232	234					
186	192	194	196	198	200	202	204	206	208	209	211	214	215	217	219	221	223	225	227	228	230	232	234				
187	191	193	195	197	198	200	202	204	206	208	210	212	214	216	217	219	221	223	225	227	229	231	232	234			
188	190	191	193	195	197	199	201	203	205	207	208	210	212	214	216	218	219	221	223	225	227	229	231	233	235		
189	188	190	192	193	195	197	199	201	203	205	206	208	210	212	214	216	218	220	221	223	225	227	229	231	233	234	
190	186	188	190	192	194	196	198	199	201	203	205	207	209	210	212	214	216	218	220	222	223	225	227	229	231	233	234
191	185	187	189	190	192	194	196	198	200	202	204	205	207	209	211	213	215	217	218	220	222	224	225	227	229	231	233
192	184	185	187	189	191	193	195	196	198	200	202	204	205	207	209	211	213	215	216	218	220	222	224	225	227	229	231
193	182	184	186	188	189	191	193	195	197	198	200	202	204	206	207	209	211	213	215	216	219	220	222	224	226	227	229
194	181	183	185	186	188	190	192	194	195	197	199	201	202	204	206	208	210	211	213	215	217	219	220	222	224	226	228

Table VII. Converting backfat thickness to a 170-pound basis

If actual weight is	Actual backfat thickness (total of three measurements in tenths of inches)																																													
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59
	Read 170-pound equivalent measurements for a given weight and backfat below (total of three measurements)																																												
130	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49																
135	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50															
140		20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50														
145			20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50													
150				21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51												
155					21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51											
160						21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51										
165							22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52									
170								22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52								
175									22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52							
180										23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53						
185											23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53						
190												23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53					
195													24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54				
200														24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54		
205															24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54		

* Developed by E. Cobb, Animal Science Department, University of Hawaii

Table VIII. Adjusting live backfat thickness to standard weight of 200 pounds*

If actual weight is	Actual backfat thickness (total of three measurements in tenths of inches)																																
	25	26	27	28	29	30	31	32	33	34	35	36	37	39	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58
	Read 200-pound equivalent measurements for a given weight and backfat below (total of three measurements)																																
160	31	32	33	34	35	37	38	39	40	42	43	44	45	46	47	49	50	51															
165	30	31	32	33	34	36	37	38	39	40	42	43	44	45	46	48	49	50	51														
170		30	31	32	34	35	36	37	38	40	41	43	43	44	45	46	47	49	50	51													
175			30	32	33	34	36	37	38	39	40	41	42	43	44	45	46	47	49	50	51'												
180			30	31	32	33	34	35	36	37	39	40	41	42	43	44	45	46	47	48	50	51											
185				30	31	32	33	34	35	36	38	39	40	41	42	43	44	45	46	47	48	49	50										
190					30	31	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	50	50	51								
195					29	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51							
200						30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51						
205							30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51					
210							30	31	32	33	33	33	35	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51			
215								30	31	32	33	34	35	36	37	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	51		
220									30	31	32	33	34	35	36	37	38	39	39	40	41	42	43	44	45	46	47	48	49	50	50	51	
225									30	31	32	33	34	35	35	36	37	38	39	40	40	41	42	43	44	45	46	47	48	48	49	50	51	
230										30	31	32	33	33	34	35	36	37	38	39	40	40	41	42	43	44	46	46	47	48	48	49	50	51

* Adapted from a table by Ralph M. Durham and John H. Zeller, U. S. Department of Agriculture (1955).